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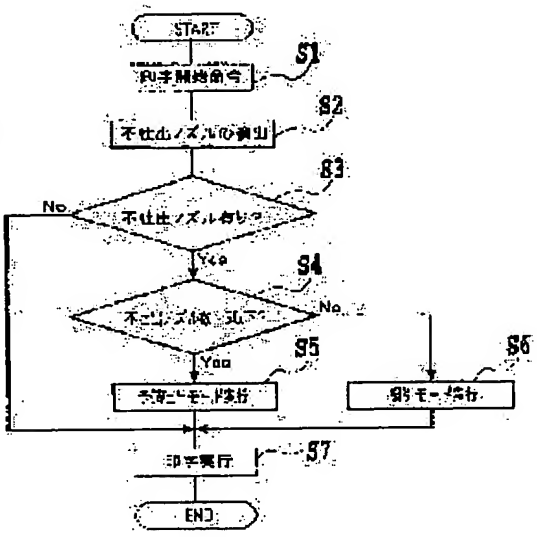
(71)Applicant : CANON INC
(72)Inventor : INUI TOSHIJI
YANO KENTARO
KATO MASAO
SAITO KENICHI
TAKAHASHI KATSUHIKO
IKEDA TETSUTO
TAKAGI SHINJI
SATO TOMONORI

(54) RECOVERY DEVICE AND METHOD FOR INK-JET RECORDING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To recover a non-ejection nozzle with the minimum necessary ink consumption.
SOLUTION: A recovery method for an ink-jet recording device for forming an image using a recording head with a plurality of nozzles for ejecting ink droplets, comprising a first step of detecting the non-ejection state of the nozzles, and a second step of executing a recovery process, which can vary depending on the non-ejection state of the nozzles detected in the first step, is provided.



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CLAIMS

[Claim(s)]

[Claim 1] The method of recovery of the ink jet recording device which is the method of recovery of the ink jet recording device which forms an image using the recording head which has two or more nozzles for carrying out the regurgitation of the ink droplet, and is characterized by having the 2nd process which performs different recovery according to the condition of the non-regurgitation of the nozzle detected at the 1st process which detects the non-discharge condition of said nozzle, and said 1st process.

[Claim 2] The method of recovery of the ink jet recording device according to claim 1 characterized by detecting the ink non-regurgitation per nozzle at said 1st process.

[Claim 3] The method of recovery of the ink jet recording device according to claim 1 characterized by performing recovery which judges the number of the non-regurgitation nozzle in said two or more nozzles, and is different at said 2nd process according to this judgment result.

[Claim 4] The recovery device of the ink jet recording device according to claim 1 characterized by choosing the recovery corresponding to the detection condition in said 1st process at said 2nd process from at least two kinds in the recovery by the reserve regurgitation mode of 1 · plurality, and the recovery by the attraction mode of 1 · · plurality.

[Claim 5] It is the method of recovery of the ink jet recording device according to claim 3 characterized by performing recovery by attraction mode when recovery by reserve regurgitation mode is performed when judged with the number of a non-regurgitation nozzle being smaller than the predetermined number at said 2nd process, and it judges that the number of a non-regurgitation nozzle is larger than the predetermined number.

[Claim 6] Two or more record components with which said ink jet recording device supplies heat energy to the substrate for recording heads of said recording head, It has the detection electrode which detects change of the electrical potential difference

generated between said record components and said driver elements according to the existence of the ink in a nozzle in case two or more driver elements and said record components for driving said record component drive. The method of recovery of the ink jet recording device according to claim 1 characterized by detecting the non-discharge condition of two or more of said nozzles based on the detection output of said detection electrode at said 1st process.

[Claim 7] The recovery device of the ink-jet recording device which chooses one and is characterized from from by to have the recovery control means which performs the selected recovery among the recoveries from which plurality differs according to the condition of the non-regurgitation of the nozzle detected by non-regurgitation detection means detect the non-discharge condition of two or more of said nozzles, and said non-regurgitation detection means, in the ink-jet recording device which forms an image using the recording head which has two or more nozzles for carrying out the regurgitation of the ink droplet.

[Claim 8] Said non-regurgitation detection means is the recovery device of the ink jet recording device according to claim 7 characterized by detecting the ink non-regurgitation per nozzle.

[Claim 9] Said non-regurgitation detection means is the recovery device of the ink jet recording device according to claim 7 characterized by judging the number of the non-regurgitation nozzle in said two or more nozzles, and detecting the non-discharge condition of a nozzle based on this judgment result.

[Claim 10] Said recovery control means is the recovery device of the ink jet recording device according to claim 7 characterized by choosing the recovery corresponding to the detection condition of said non-regurgitation detection means from at least two kinds in the recovery by the reserve regurgitation mode of 1 - plurality, and the recovery by the attraction mode of 1 - plurality.

[Claim 11] It is the recovery device of the ink jet recording device according to claim 9 characterized by performing recovery by attraction mode when recovery by reserve regurgitation mode is performed when judged with said recovery control means having the number of a non-regurgitation nozzle smaller than the predetermined number, and it judges that the number of a non-regurgitation nozzle is larger than the predetermined number.

[Claim 12] Two or more record components with which said ink jet recording device supplies heat energy to the substrate for recording heads of said recording head, It has two or more driver elements for driving said record component. Said non-regurgitation detection means It has the detection electrode which detects change of the electrical

potential difference generated between said record components and said driver elements according to the existence of the ink in a nozzle in case said record component drives. The recovery device of the ink jet recording device according to claim 7 characterized by detecting the non-discharge condition of two or more of said nozzles based on the detection output of this detection electrode.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the method of recovery and equipment which detect the non-discharge condition of the nozzle of an ink jet recording head, and perform recovery to a recording head in more detail about the method of recovery of an ink jet recording apparatus.

[0002]

[Description of the Prior Art] By heating the heater formed in the ink regurgitation nozzle with which current and ink were filled up, make air bubbles generate rapidly in a nozzle, ink is made to inject from a nozzle head by the thrust of these air bubbles, and the ink jet recording device of the method which performs image recording is increasing rapidly by making ink reach the record medium which counters. However, according to the passage of time, air bubbles are gradually generated in an ink regurgitation nozzle, the condition that those air bubbles become a cause and the regurgitation of the ink cannot be carried out from a nozzle occurs, and it is known for the recording device of this method that poor record will occur as a result.

[0003] Moreover, the ink which stays in a nozzle fixes in a nozzle with the passage of time, and it is known that the ink non-regurgitation at the time of image recording will arise.

[0004] Performing recovery action which sucks the ink in a nozzle out of the exterior compulsorily (drawing in), and cancels the poor regurgitation of ink is known for this kind of ink jet recording device to the trouble known from these former.

[0005] And in the above-mentioned recovery action, attraction recovery action is performed to timing decided beforehand, such as a power up, or the elapsed time from the last recovery action is measured with a timer, and it is determined whether perform attraction recovery according to the elapsed time.

[0006] However, since comparatively much ink will be discharged if attraction actuation is performed, in the semantics of pressing down consumption of useless ink, it is necessary to lessen the count of attraction actuation as much as possible. Moreover, there was no guarantee that the poor ink regurgitation always had not occurred also just because it performed attraction recovery action.

[0007] Then, some detection systems for carrying out direct detection of the ink droplet after being conventionally breathed out from the nozzle are proposed. The technique which distinguishes whether the channel mistake (non-regurgitation) has arisen is indicated by JP,61-123545,A by detecting an output signal when the liquid ink drop injected from the nozzle carries out a flight collision to a channel mistake detector after fixed time amount progress. and when the channel mistake has arisen, he is trying to cancel the non-discharge condition which purge ink passage of a print head all at once (attraction) according to twist ****** etc. especially

[0008]

[Problem(s) to be Solved by the Invention] However, the recovery after detecting the non-regurgitation of a nozzle will consume ink vainly only by attraction like the above-mentioned conventional technique. Consequently, it will be necessary to make buildup of a running cost, and the capacity of the waste ink absorber which holds the attracted ink in the body of a printer etc. increase, and buildup of equipment size or equipment cost will be caused.

[0009] While this invention is made in order to improve **** between the above, and detecting the non-discharge condition of the nozzle of an ink jet recording head, when a nozzle suits a non-discharge condition, it aims at offering the method of recovery and equipment of an ink jet recording device which can make a normal condition recover useless ink, without making it generated as much as possible.

[0010]

[Means for Solving the Problem] It is the method of recovery of the ink jet recording device which forms an image using the recording head which has two or more nozzles for carrying out the regurgitation of the ink droplet with one gestalt of this invention, and is characterized by having the 2nd process which performs different recovery according to the condition of the non-regurgitation of the nozzle detected at the 1st process which detects the non-discharge condition of said nozzle, and said 1st process.

[0011] At said 2nd process, the number of the non-regurgitation nozzle in said two or more nozzles is judged, and different recovery according to this judgment result is performed, for example. As two or more different recoveries, at least two kinds in the recovery by the reserve regurgitation mode of 1 · plurality and the recovery by the

attraction mode of 1 · plurality are chosen, for example. And for example, although recovery in reserve regurgitation mode with little ink consumption is performed, and recoverability ability is powerful compared with reserve regurgitation mode when there are many non-regurgitation nozzles when there are few non-regurgitation nozzles, recovery by attraction mode with much ink consumption is performed.

[0012] Moreover, a non-regurgitation detection means to be the recovery device of the ink jet recording device which forms an image using the recording head which has two or more nozzles for carrying out the regurgitation of the ink droplet with other gestalten of this invention, and to detect the non-discharge condition of two or more of said nozzles, Among the recoveries from which plurality differs according to the condition of the non-regurgitation of the nozzle detected by said non-regurgitation detection means, from from, one is chosen and it is characterized by having the recovery control means which performs selected recovery.

[0013]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to a drawing.

[0014] (Configuration for non-regurgitation detection) The method which prepares the electrode for non-regurgitation detection in the silicon substrate which constitutes a recording head is first explained as the non-regurgitation detection technique of ink applicable to this invention.

[0015] Drawing 1 is drawing showing the fundamental configuration of the substrate for recording heads.

[0016] In drawing 1 , the heating element 101 as a record component for giving the heat energy for ink regurgitation to ink is arranged at the component substrate 100 which is a substrate for recording heads. Moreover, the power transistor (driver) 102 for driving each heating element 101 is formed to two or more heating elements (record component) 101 arranged by juxtaposition. Furthermore, on the component substrate 100, two or more AND gates 115 are formed with the shift register 104 and the latch circuit 103. A shift register 104 inputs the serial clock which inputs image data serially from the exterior through a terminal 106, and synchronizes with this from a terminal 105, and holds the image data for one line. A latch circuit 103 latches the image data for one line outputted to parallel from the shift register 104 synchronizing with the clock for a latch (latch signal) inputted through a terminal 107, and transmits it to a power transistor 102 at parallel. Two or more AND gates 115 are formed corresponding to a power transistor 102, respectively, and impress the output signal of a latch circuit 103 to a power transistor 102 according to the enable signal from the outside. 108 is a driving

pulse signal input (heat pulse) terminal for controlling the ON time amount of the power transistor 102 which is a driver element, i.e., the time amount which passes and drives a current to a heating element 101, from the outside of the recording head section. 109 is a terminal for inputting the actuation power source (5V) of a latch circuit 103 or the logical circuit of shift register 104 grade. Furthermore, the terminal 112 grade for actuation and the monitors of the sensor 114 besides an earth terminal 110 is prepared. Thus, the terminals 105-112 formed on a substrate 100 are input terminals for inputting image data, various signals, etc. from the outside.

[0017] Moreover, the sensors 114, such as a resistive sensor for measuring the temperature sensor for measuring the temperature of the component substrate 100 or the resistance of each heating element 101, are formed in the component substrate 100.

[0018] Furthermore, the electrode 118 for detection for detecting a non-regurgitation nozzle is formed in the component substrate 100. The detection electrode 118 is combined with the actuation circuit of a heater 101 in alternating current through a protective coat 405, the cavitation-proof film 205, and the ink in a nozzle so that it may mention later. 116 in drawing 1 is the alternating current-bond part, and constitutes an equal circuit as a capacitor like drawing 6 . It is a part in the nozzle from which electric resistance changes according to the abundance of ink, and D in drawing 6 expresses the driving signal from the AND gate 115 so that the part surrounded by the two-dot chain line B in drawing 6 may be mentioned later.

[0019] In such a configuration, the image data inputted as a serial signal is changed into a parallel signal by the shift register 104, and is held with it at a latch circuit 103 synchronizing with the clock for a latch. Through an input terminal 107, by inputting the driving pulse signal (enable signal to the AND gate 115) of a heating element 101, a power transistor 102 is turned on according to image data, a current flows to the corresponding heating element 101, and heat energy occurs in this condition. In order to form the liquid flow channel for the ink regurgitation (it is also called a nozzle), its liquid flow channel, and a common liquid room open for free passage, a top plate is joined to the component substrate 100. Thus, by constituting, the ink held in an ink tank (it is also called the ink hold section) is supplied to each nozzle through a common liquid room, and adequate supply of ink is attained. As mentioned above, by the heat energy generated by actuation of a heating element, the ink in a liquid flow channel (nozzle) is heated, and ink is breathed out as a drop from the delivery at the head of a nozzle.

[0020] Drawing 2 is the top view showing the outline configuration of the substrate for ink jet recording heads shown in drawing 1 , and the outline of layouts, such as a

component prepared on a substrate, an electrode, and a terminal, is shown. Drawing 3 is the outline perspective view showing the condition of having joined the top plate for constituting a delivery and a nozzle to the substrate for ink jet recording heads shown in drawing 1 and drawing 2 . Moreover, drawing 4 is the sectional view showing the configuration of a substrate and a nozzle in the condition of having joined the top plate to the substrate for ink jet recording heads. In addition, this drawing 4 is a sectional view which meets the arrow-head a-a line in drawing 3 . Moreover, drawing 5 is drawing showing the condition of the electrical potential difference of each part on the substrate for ink jet recording heads when driving the heater element which is a record component.

[0021] 101 shown in drawing 2 is a heating element (a heater is called hereafter) used as a record component, and is driven by the driver 102 which is a driver element. 203 is wiring which connects between the end section of a heater 101, and drivers 102, and 111 is wiring for supplying supply voltage to the other end of a heater 101. Moreover, on the heater 101, the protective coat 405 (protective layer) insulated electrically is formed like drawing 4 , and the cavitation-proof film 205 is arranged above the heater 101 through this protective coat 405. In addition, in drawing 2 , in order to explain arrangement of a heater 101 and driver 102 grade, the graphic display of a protective coat 405 is omitted. Moreover, the ink jet recording head explained by this example generates air bubbles in the ink in a nozzle with the heat energy generated when a heater 101 drives, and the so-called bubble jet (trademark) method which carries out the regurgitation of the ink from a delivery 310 (refer to drawing 3 and drawing 4) with the growth pressure of the air bubbles is used for it. An impact when the air bubbles generated when carrying out the regurgitation of the ink contract is established in order to play the role which stops getting across to a heater 101 or a protective coat 405, and the above-mentioned cavitation-proof film 205 is formed with refractory metals, such as a tantalum. 118 is electrode wiring prepared for ink detection, and 117 is an external terminal for being prepared in the edge of the electrode wiring 118 and connecting the electrode wiring 118 to the substrate exterior electrically.

[0022] As shown in drawing 2 , the configuration which arranged the configuration which has divided and arranged the cavitation-proof film 205 every heater (record component) 101, and the detection electrode 118 in the location which is distant from a driver 102 and is distant from a heater 101 and the wiring 203 between drivers 102 has the characteristic configuration of this substrate for recording heads. The detection electrode 118 can be formed as a circuit pattern.

[0023] In the configuration of the substrate for ink jet recording heads shown in this

drawing 2 , it explains to a detail below how the existence of the ink in a nozzle is detected with reference to drawing 3 and drawing 4 .

[0024] As mentioned above, drawing 3 is the outline perspective view showing the condition of having joined the top plate 314 to the substrate 100 for ink jet recording heads, and the nozzle section 408 (refer to drawing 4) and the common liquid room 311 are constituted by joining a top plate 314 and a substrate 100. In addition, at this drawing 3 , in order to explain the configuration of the nozzle section 408 and the common liquid room 311, it expresses with the dotted line about the configuration of the upper wall material of a top plate 314. Moreover, as shown in drawing 2 , 205 is the cavitation-proof film. moreover, the heater 101 which is a record component as mentioned above -- the bottom of the cavitation-proof film 205 -- being located -- in addition -- and since the insulating protective coat 405 is formed in the upper part of a heater 101, the heater 101 is not illustrated in drawing 3 . Moreover, it is not illustrated [in / the same is said of the driver 102 for driving a heater 101, and / drawing 3], either.

[0025] In this invention, the part of the heater 101 (drawing 3 un-illustrating) containing the cavitation-proof film 205 arranged by dissociating for every nozzle, a driver 102 (drawing 3 un-illustrating), the nozzle section 408 formed with the nozzle wall 312, the detection electrode 118 for ink detection, and the relation of ** become important.

[0026] In drawing 4 , the actuation power supplied through the power-source wiring 111 from a power supply section is given to a heater 101 according to switching by the driver 102, and generates heat energy. Air bubbles are generated in a nozzle with this heat energy, and ink is breathed out from a delivery 310.

[0027] the event of the phase 102, i.e., a driver, before a heater 101 drives by switching of a driver 102 being OFF here -- setting -- the potential of the heater 101, the potential of the wiring 203 between a heater 101 and a driver 102, and the part on a driver 102 -- the potential of wiring (part by the side of [the part which acts as a switch in a driver 102 to] a heater 101) is the same as the potential of the heater power-source wiring 111 respectively. Moreover, it is in the condition of high impedance in direct current to the condition in which it floated electrically like ink that ink (there is conductivity since ion is generally contained in the ink component) has floated electrically, i.e., ink, as for the potential of the cavitation-proof film 205 on the protective coat 405 which turns into an insulator layer electrically by being in the condition of high impedance in direct current to GND, i.e., GND, (gland). Similarly the potential of the detection electrode 118 will also be in the condition of having floated electrically fundamentally, and the input impedance of the equipment connected in order to detect the potential of the detection

electrode 118 will determine the potential mostly. In this example, in order to detect the potential of the detection electrode 118, voltage monitor M and resistance of 1M-10M omega were connected to juxtaposition between the detection electrode 118 and GND like drawing 4 . Therefore, detection potential is set to 0V in the phase before actuation of a heater 101.

[0028] On the other hand, when a heater 101 is driven (i.e., when it switches so that a driver 102 may connect wiring 203 to GND (ON)), though natural, a current flows at a heater 101. In that case, potential falls, so that a heater 101 is close to a driver 102 side, and the potential the wiring 203 between a heater 10 and a driver 102 and up [driver 102] which is wiring a part descends rapidly on GND level mostly. In drawing 4 , the part surrounded by the dotted line A shows the part into which an electrical potential difference falls rapidly at the time of actuation of a heater 101. Thus, when an electrical potential difference descends and the protective coat 405 which was working as an insulator layer in direct current works as a dielectric film of a capacitor showed that potential change was transmitted to the cavitation-proof film 205 gone across and prepared on the driver 102 from on the heater 101 through the protective coat 405, and the ink located on it in alternating current. Therefore, when ink exists in the nozzle section 408 and the common liquid chamber portion 311, the potential change will be transmitted to the detection electrode 118. Moreover, since the electric resistance in the nozzle section 408 between the part and detection electrode 118 and/or the common liquid chamber portion 311 becomes remarkably large although potential change is transmitted to the part of the cavitation-proof film 205 when ink does not exist in the nozzle section 408 and/or the common liquid chamber portion 311, potential change transmitted to the detection electrode 118 does not become remarkably small as a result, or potential change is no longer transmitted to the detection electrode 118. Thus, the abundance of the part of the driven heater 101 and the ink between the detection electrodes 118 and the existence of ink are detectable from the abundance of the ink in the nozzle section 408 or the common liquid chamber portion 311, and potential change of the detection electrode 118 differing according to the existence of ink extremely.

[0029] In drawing 2 and drawing 4 , the part surrounded by the dotted line B shows the part from which electric resistance changes with the abundance of ink, i.e., the part which has large effect on potential change of the detection electrode 118. Moreover, the part surrounded by the dotted line 116 in drawing 2 is equivalent to the alternating current-bond part in drawing 1 and drawing 11 .

[0030] Drawing 5 is a timing chart for explaining detection actuation of the ink using the above detection principles. 701 is an enable signal which decides on the timing

which drives a heater 101, and actuation time amount. A heater 101 is driven according to an individual one by one synchronizing with an enable signal based on the signal for driver actuation control (not shown). 703 is the potential of the wiring 203 between a heater 101 and a driver 102, and the potential of the part of a heater 101 near a driver 102 side and the potential up [driver 102] which is wiring (part by the side of [the part which acts as a switch in a driver 102 to] a heater 101) a part as well as change of this potential 703 change. The part from which an electrical potential difference changes is also called electrical-potential-difference change field including these parts. In addition, the amplitude of change of potential changes with the locations on a heater 101, and it becomes so large that it is close to a driver 102 side. Moreover, it is thought that the surface potential of the insulating protective coat 405 is almost the same as the potential of the electrical-potential-difference change field under it. 704 and 705 are the detecting signals of the ink obtained by potential change of the detection electrode 118, and a detecting signal in case a detecting signal 704 has ink in the part B in drawing 4 , and a detecting signal 705 are detecting signals in case there is no ink in the part B. Since the electric resistance of the B part is small when ink is in Part B, potential change detected with the detection electrode 118, as a result change of a detecting signal 704 become large. On the other hand, since the electric resistance of the B part is large when there is no ink in Part B, potential change detected with the detection electrode 118, as a result change of a detecting signal 704 become small. Thus, it turns out that the detecting signal detected with the detection electrode 118 changes with the cases where there is nothing with the case where ink is in Part B. Of course, according to the abundance of the ink in Part B, the detecting signal detected with the detection electrode 118 changes.

[0031] The detecting signal from such a detection electrode 118 can detect the existence of ink, or the abundance of ink for every actuation nozzle by carrying out time sharing according to the actuation timing of a heater 101. The detecting signal 704 in drawing 7 is a detecting signal in case there is ink in all the actuation nozzles, and the detecting signal 705 in drawing 7 is a detecting signal in case there is no ink in all the actuation nozzles similarly. When it follows, for example, there is no ink in one actuation nozzle, only the detecting signal corresponding to the actuation nozzle will appear as a small detecting signal 705 of change, and the detecting signal corresponding to other actuation nozzles will appear as a large detecting signal 705 of change.

[0032] In addition, the potential change for every nozzle according to the existence of ink can be detected certainly, without being influenced of the adjoining nozzle, since the cavitation-proof film 205 was made to correspond to a heater 101 and it has dissociated.

Moreover, while making the cavitation-proof film 205 correspond to a heater 101 in this way and dissociating, the existence of the ink in each of two or more arranged nozzles is detectable with the detecting signal from one detection electrode 118 by using the electrode 118 by the side of detection in common to all nozzles, and driving each nozzle by time sharing one by one.

[0033] Moreover, it becomes possible to detect existence of ink with a very simple configuration, without being able to perform detection of the existence of the ink of each nozzle unit using the logical circuit prepared in the recording head that a shift register etc. should be constituted conventionally, and complicating structure as a source of a signal of the detecting signal of ink, since heater 101 itself can be used.

[0034] (Configuration for other non-regurgitation detection) Drawing 7 is an outline block diagram for explaining the configuration for other non-regurgitation detection applicable to this invention.

[0035] In drawing 7 , 11 is a recording head in an ink jet recording device. The nozzle 12 for filling up with ink in the recording head 11, and carrying out the regurgitation of the ink is arranged. In the nozzle, the heater 13 driven with the liquid regurgitation means (not shown) for sending out ink by the predetermined timing pattern is arranged for every nozzle. By energizing and heating a heater 13, air bubbles are generated in the ink of a nozzle and the regurgitation of the ink droplet is carried out in the direction of a nozzle orifice by the thrust. Although 14 is an ink droplet after the regurgitation, it arranges the non-regurgitation detection means 15 in the middle of the transit route of this ink droplet in the location which does not contact an ink droplet, and detects existence of ink passage by non-contact to an ink droplet.

[0036] The ink droplet 14 is heated by the heat of a heater 13 at the time of the regurgitation, and since the radiation wave reinforcement of an infrared wavelength range is high also especially in the radiation wave which an ink droplet emits, it is desirable to use the infrared sensor which detects the radiation wave of an infrared wavelength range as a non-regurgitation detection means. As a typical infrared sensor, the pyro infrared sensor using the pyroelectric element which produces potential change by the infrared wavelength wave is known.

[0037] Since the output of the non-regurgitation detection means 15 changes whenever the breathed-out ink droplet passes, it can detect the existence of passage of an ink droplet by detecting the existence of this change with the output detection means 16.

[0038] (Whole configuration) Drawing 8 is general-view drawing of the ink jet recording device IJRA which can apply this invention.

[0039] In this drawing, the forward inversion of the leading screw 84 is carried out by

the forward counterrotation of a drive motor 81 through the driving force transfer gears 82 and 83. Carriage HC has the pin (un-illustrating) engaged to the spiral slot of a leading screw 84, and both-way migration is carried out in the arrow head a and the direction of b of [in drawing] according to the hand of cut of a leading screw 84. The head cartlidge IJH which consists of an ink jet recording head 85 and an ink tank 86 is carried in this carriage HC. The ink jet recording apparatus IJRA shown in this drawing 8 is a recording apparatus generally called a serial printer, and record actuation to the whole surface of a record sheet 87 is performed by repeating horizontal scanning which met in the arrow head a and the direction of b of Carriage HC, and vertical scanning of the record sheet 87 which is recorded media.

[0040] The attraction recovery system unit 88 is formed in the left end side of the movable field of Carriage HC so that it may counter with each ink delivery of the recording head 85 on Carriage HC. This attraction recovery system unit 80 is equipped with the pump (un-illustrating) for attracting each nozzle to ink etc. through the ink way from the cap member 89 which carries out capping of the face side of a recording head 85, the wiper blade 90 which carries out wiping of the face side of a recording head 85, and said cap. Attraction recovery action for keeping good the ink discharge condition of a recording head 85 with this attraction recovery system unit 88 is performed.

[0041] Moreover, near the cap member, the reserve regurgitation ink receptacle (not shown) which receives the ink breathed out in the case of the reserve regurgitation mentioned later is arranged.

[0042] Drawing 9 is the block diagram showing the configuration of the important section of the control section for performing record control of the recording apparatus shown in drawing 8 .

[0043] In drawing 9 , it is the interface whose 1100 1000 inputs a control circuit and inputs a record signal, and an interface 1100 receives the data transmitted from the host device connected to the exterior of a recording apparatus IJRA. Program ROM and 1003 which store the control program with which MPU performs 1001 and MPU1001 performs 1002 are RAM of the dynamic mold which saves various data (record data supplied to an above-mentioned record signal and an above-mentioned head). 1004 is a gate array which performs supply control of the record data to a head cartlidge IJH, and also performs interface 1100 and data transfer control between MPU1001 and RAM1003. A carrier motor for 1009 to scan the carriage HC (drawing 8) which carried the head cartlidge IJH, and 1008 are the conveyance motors for conveying the recording paper 87 which is recorded media. Moreover, 1006 and 1007 are Motor Driver for driving the conveyance motor 1008 and the carrier motor 1009, respectively.

[0044] 1117 is a signal line connected to the terminal 117 shown in drawing 1 and drawing 2 , and is electrically connected with the detection electrode 118 of the substrate 100 for ink jet recording heads through the terminal 117. At the time of detection of ink, the electrical-potential-difference change according to the amount of ink (existence of ink) is inputted into the control circuit 1000 of the body of equipment through a signal line 1117 from a terminal 117. 1012 is a signal line including the enable signal for driving the heater 101 which is a record component, the clock signal inputted into the logical circuit on the component substrate 100, a latch signal, etc. for outputting various signals. Moreover, 1016 is a signal line which supplies the actuation power for driving the heater 101 as a record component from a non-illustrated power supply section to a head cartlidge IJH. 1017 is a signal line for supplying power to the logical circuit of the component substrate 100 for recording heads carried in a head cartlidge IJH.

[0045] In the configuration of such a control section, while driving a heater 101 to the timing of arbitration, the existence of the ink in a nozzle is detectable by inputting the detecting signal obtained with the detection electrode 118 on the component substrate 100 through a signal line 1117 and a terminal 117, and carrying out the monitor of it. In addition, about the timing which detects existence of such ink, when omitting record actuation to recorded media, the existence of the ink for every nozzle can be detected by driving every nozzle one by one, for example. Generally, in order to recover the discharge condition of an ink jet recording head in an ink jet recording apparatus, performing only the regurgitation without attracting reserve discharging which makes ink breathe out preparatorily, i.e., ink, is known, and the condition about the existence of the ink of each nozzle can be separately detected by using the timing of this reserve discharging. Of course, ink is also detectable during record actuation.

[0046] MPU1001 which is the control means established on the control circuit can perform the monitor of the signal acquired with the detection electrode 118. In addition, by matching the driven heater 101 and change of the potential of the detection electrode 118, the existence of ink can be detected about each of the arranged nozzle, and the nozzle which the condition that ink is lost and the regurgitation of ink cannot be performed has generated, or a nozzle with the possibility of the ink non-regurgitation can be specified.

[0047] (Method of recovery) The method of recovery which recovers the discharge condition of the nozzle of the non-regurgitation next is explained.

[0048] Drawing 10 (a) is an example of the outline configuration of the recording head 85 carried in an ink jet recording device. This recording head 85 is equipped with 64

nozzles N1-N64 in all, and the heater (not shown) for producing and cheating out of air bubbles and making ink breathe out by that thrust is arranged in each nozzle N1 - N64.

[0049] Drawing 10 (b) and (c) show the result of having detected the non-discharge condition of each nozzle of the recording head shown by drawing 7 (a) with the above-mentioned non-regurgitation detection means, and presuppose that the nozzle smeared away black is a non-discharge condition.

[0050] In the case of drawing 10 (b), the condition that the nozzle N3 and the nozzle N62 became the non-regurgitation among the nozzles arranged is shown. Such in a condition, if it draws in as recovery, many useless ink will be consumed. Such in a condition, when air bubbles exist in the corresponding non-regurgitation nozzle in many cases and air bubbles exist in the nozzle of such a fraction, the air bubbles which remain in a head can be discharged by performing the reserve regurgitation which performs only the regurgitation without drawing in.

[0051] performing the reserve regurgitation for discharging air bubbles to the exterior of a recording head on conditions which make the liquid room for supplying ink to a nozzle or a nozzle produce the turbulent flow of ink -- desirable -- as a concrete example -- the odd-numbered nozzle and the even-numbered nozzle -- from predetermined -- the technique repeated by turns every [several] is raised.

[0052] since the nozzle more than a moiety is the non-regurgitation on the other hand in the case of drawing 7 (c) -- for example, said odd-numbered nozzle and even-numbered nozzle which were carried out -- from predetermined -- even if it performs the reserve regurgitation on the conditions repeated by turns every [several], since it is the non-regurgitation from the first, it is hard to produce the flow of a nozzle or the ink in the liquid interior of a room, and, as a result, hard to lead to blowdown of air bubbles. Therefore, as recovery in such a case, it can say that it is more desirable to draw in rather than the reserve regurgitation.

[0053] Moreover, the cause of the non-regurgitation is not based on air bubbles, for example, although the attraction is more effective than the reserve regurgitation when it is fixing of the ink in a nozzle, with the non-regurgitation detection means mentioned above, it cannot specify to the cause of the non-regurgitation. Then, the reserve regurgitation is given at first in a condition like drawing 7 (b), and if it is made to draw in when detecting a non-discharge condition again and still not returning to normal after it, generating of useless ink can be prevented compared with drawing in unconditionally.

[0054] (Example 1 of recovery) Drawing 11 is a flow chart which shows the 1st example of the method of recovery of an ink jet recording apparatus, and explains the actuation

based on drawing 11 below. This flow chart shows the operations sequence in the control circuit 1000 of drawing 9 .

[0055] First, an input of a printing initiation instruction detects a non-regurgitation nozzle with the above-mentioned non-regurgitation nozzle detection equipment (step S2). (step S1) And when it distinguishes whether a non-regurgitation nozzle exists based on this detection result (step S3) and a non-regurgitation nozzle does not exist, a procedure is made to shift to step S7, and printing actuation is performed.

[0056] On the other hand, when judged with there being a non-regurgitation nozzle, extent of a non-discharge condition is diagnosed next (step S4).

[0057] Namely, recovery action by reserve regurgitation mode is performed at the time of below the predetermined number n (in this case, five pieces) which the number of non-regurgitation nozzles set up beforehand (step S5). Moreover, when a non-regurgitation nozzle exceeds n pieces, recovery action by attraction mode is performed (step S6).

[0058] And if the recovery in step S5 or step S6 is ended, a procedure will be advanced to step S7 and printing actuation will be performed.

[0059] Drawing 12 is a timing diagram explaining reserve regurgitation mode, in the reserve regurgitation shown in this drawing 12 , after it makes the odd-numbered nozzle of 256 shots breathe out, it makes 1 cycle discharging which makes the even-numbered nozzle of 256 shots breathe out, and it is a total of 20 cycle ******** about this. The ink consumption in this reserve regurgitation mode becomes 15x256x256x20x10-9= 0.02 cc in general, when the specific gravity of ink is set to 1.

[0060] On the other hand, in the attraction mode in step S6, after the ink tank became empty, it considered as the same thing as the attraction actuation performed when exchanged for a new ink tank. In the case of the recording head used for this example, it was made into about 0.15 cc although the required amount of attraction in this case was set up according to the configuration of a recording head etc. Consequently, the difference of one about 7.5 times the ink consumption of this was made in reserve regurgitation mode and attraction mode.

[0061] In order to check the effectiveness of the method of recovery explained above, when it grasps the non-discharge condition beforehand and the non-regurgitation detection and recovery by this example were performed, the non-regurgitation nozzle was able to be lost and normal printing was able to be performed.

[0062] In addition, reserve regurgitation mode is not limited to what was shown in drawing 12 , and as shown in drawing 13 , you may make it change the combination of the nozzle which carries out the regurgitation simultaneously, the number of shots, the

frequency of a regurgitation cycle, etc. to arbitration.

[0063] Moreover, although it distinguished whether the number of non-regurgitation nozzles would exceed five or less nozzles and five nozzles in step S4 of drawing 11 , distinction threshold n of the number of non-regurgitation nozzles is not limited to this.

[0064] Furthermore, it is also effective to raise recoverability more by judging the condition of a non-regurgitation nozzle in a detail more. For example, even if it is the non-regurgitation of the five same nozzles, recovery may be divided by the case where this non-** 5 nozzle continues like [at the time of generating for the nozzles N1-N5 of drawing 10], and the case where a non-** nozzle exists intermittently. that is, since the turbulent flow of the ink in a nozzle is comparatively alike and it is hard coming to generate it in reserve regurgitation mode when continuing, as long as the non-regurgitation nozzle which will perform attraction mode and will continue if three nozzles are non-regurgitation continuously even if it is five or less nozzles, for example is two or less nozzles, it may be made to perform reserve regurgitation mode.

[0065] Moreover, although non-regurgitation detection performed the printing instruction after the carrier beam in this example, it may be made to perform non-regurgitation detection at the events after printing the event of being made to carry out also after not being limited to this, for example, completing printing actuation, or predetermined printing number of sheets being completed, and the predetermined number of dots.

[0066] (Example 2 of recovery) Drawing 14 is a flow chart which shows the 2nd example of the method of recovery of an ink jet recording apparatus, and explains the actuation based on drawing 14 below.

[0067] In this 2nd example, as shown in step S13, distinction threshold n of the number of non-regurgitation nozzles is used as ten nozzles, when the number of non-** nozzles is ten or less, attraction mode A is performed (step S14), and when there are more non-** nozzles than 10, it is made to perform attraction mode B (step S15). Since recoverability is usually high compared with the reserve regurgitation, attraction is making distinction threshold n of the number of non-regurgitation nozzles increase compared with the example of drawing 11 R> 1.

[0068] The attraction mode A has set up the amount of attraction few compared with the attraction mode B, and makes it the amount of attraction required to cover the volume near the nozzle section. The required amount of attraction is set up by the configuration of a recording head, and was set to about 0.15 cc in about 0.05 cc and the attraction mode B, for example in the attraction mode A at this example.

[0069] Also in the method of recovery of this example, effectiveness was able to be

checked to the recoverability of a non-regurgitation nozzle like the 1st previous example.

[0070] (Example 3 of recovery) Drawing 15 is a flow chart which shows the 3rd example of the method of recovery of an ink jet recording apparatus, and explains the actuation based on drawing 15 below.

[0071] The example of **** 3 adds the check actuation which detects a non-regurgitation nozzle again after activation of the recovery in the 1st example shown in previous drawing 11 .

[0072] That is, in drawing 15 , step S20 - step S25 are equivalent to steps S1-S6 of previous drawing 11 .

[0073] After recovery by the reserve regurgitation mode in step S24 or recovery by the attraction mode in step S25 is performed, in step S26, a non-regurgitation nozzle is detected again.

[0074] When a non-regurgitation nozzle does not exist as a result of the re-judging of step S26, it prints by advancing a procedure to step S29, but when a non-regurgitation nozzle exists, a procedure is advanced to step S28, and after performing re-degree, it is made to print the same attraction actuation as step S25 at step S29.

[0075] Thus, in the method of recovery by the example of **** 3, since a non-regurgitation nozzle is detected twice, recoverability improves more.

[0076] In addition, since a non-discharge condition will usually be canceled if attraction mode is performed In the flow chart of drawing 15 , when ****** mode is performed at step S24, shall restrict detection of the non-regurgitation nozzle in step S27, and it shall be performed. When attraction mode of step S25 is performed, you may make it change the procedure of drawing 15 , without advancing a procedure to step S26, so that printing actuation may be performed promptly.

[0077] Moreover, in the example mentioned above, although the example which controls recovery action on the basis of the number of the nozzle used as the non-regurgitation was given and explained, since the totals of all the nozzles prepared in a recording head also differ, in the configuration of equipment or a recording head, it is not limited to the number mentioned above. That is, when the number of the nozzles prepared in a recording head differs from what was indicated by the above-mentioned example, the number of nozzles of the non-regurgitation which serves as a decision criterion with the number of nozzles is decided. In addition, in this invention, as a decision criterion which controls recovery action, it is not restricted to the number of the nozzle used as the non-regurgitation, and is good also considering the ratio of the number of nozzles of the non-regurgitation to the total number of nozzles as a decision criterion.

[0078] Moreover, about the configuration for detecting whether it is the

non-regurgitation for every nozzle, it is also possible for it not to be limited to a configuration which was mentioned above and to adopt various well-known techniques. As a configuration which detects generating of the poor regurgitation for every nozzle, a test pattern records on record media, such as paper, for example, and the technique into which the information about the nozzle which the poor regurgitation generated makes input, the technique of detecting the nozzle which read the recorded pattern by the optical sensor and the poor regurgitation generated, etc. are known based on the result to which a user checked the recorded pattern visually. In this invention, such technique is employable suitably.

[0079] However, in the technique of checking a test pattern by viewing of a user, the case where the error of a check by the user, the error at the time of inputting the information about the nozzle of the non-regurgitation by the user, etc. occur can be considered. Moreover, in order to make the recorded pattern correspond for every nozzle in the configuration detected by the sensor and to read a pattern, there is a problem that it is difficult to match with accuracy the location which the precision of a sensor was required and has generated the non-regurgitation, and a nozzle.

[0080] This invention can reduce ink consumption effectively while being able to perform recovery efficiently by adopting the principle of detection which was explained with reference to drawing 1 thru/or drawing 6 , being able to detect to accuracy the condition that the non-regurgitation occurred per nozzle by detecting the condition that the non-regurgitation occurred per nozzle, and controlling recovery about two or more nozzles prepared in a recording head according to the detection result.

[0081] In addition, in the operation gestalt mentioned above, the bubble jet recording method which carries out the regurgitation of the ink, using a heating element as a record component was explained to the example. However, it is possible also in other recording methods to detect electrical-potential-difference change generated when a record component is driven through ink. Therefore, this invention is widely applicable to other recording methods which used not only a bubble jet recording method but the piezoelectric device.

[0082] (in addition to this) In addition, especially this invention is equipped with means (for example, an electric thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used also in an ink jet recording method in order to make the ink regurgitation perform, and brings about the effectiveness which was excellent in the recording head of the method which makes the change of state of ink occur with said heat energy, and the recording device. It is because the densification of record and highly minute-ization can be attained according to this method.

[0083] About the typical configuration and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 description and the 4740796 description, for example is desirable. Although this method is applicable to both the so-called mold on demand and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the case of the mold on demand By impressing at least one driving signal which gives the rapid temperature rise which supports recording information and exceeds nucleate boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the air bubbles in the liquid (ink) corresponding to this driving signal can be formed by one to one as a result, it is effective. A liquid (ink) is made to breathe out through opening for regurgitation by growth of these air bubbles, and contraction, and at least one drop is formed. If this driving signal is made into a pulse configuration, since growth contraction of air bubbles will be performed appropriately instancy, the regurgitation of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable. As a driving signal of this pulse configuration, what is indicated by the U.S. Pat. No. 4463359 description and the 4345262 description is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 description of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed.

[0084] As a configuration of a recording head, the configuration using the U.S. Pat. No. 4558333 description and U.S. Pat. No. 4459600 description which indicate the configuration arranged to the field to which the heat operation section other than the combination configuration (a straight-line-like liquid flow channel or right-angle liquid flow channel) of a delivery which is indicated by each above-mentioned description, a liquid route, and an electric thermal-conversion object is crooked is also included in this invention. In addition, the effectiveness of this invention is effective also as a configuration based on JP,59-138461,A which indicates the configuration whose puncturing which absorbs the pressure wave of JP,59-123670,A which indicates the configuration which uses a common slit as the discharge part of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to a discharge part. Namely, no matter the gestalt of a recording head may be what thing, it is because it can record now efficiently certainly according to this invention.

[0085] Furthermore, this invention is effectively applicable also to the recording head of

the full line type which has the die length corresponding to the maximum width of the record medium which can record a recording device. As such a recording head, any of the configuration which fills the die length with the combination of two or more recording heads, and the configuration as one recording head formed in one are sufficient.

[0086] In addition, this invention is effective also when the thing of a serial type like the example of a top also uses the recording head fixed to the body of equipment, the recording head exchangeable chip type to which the electric connection with the body of equipment and supply of the ink from the body of equipment are attained by the body of equipment being equipped, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one.

[0087] Moreover, as a configuration of the recording device of this invention, since the effectiveness of this invention can be stabilized further, it is desirable to add the regurgitation recovery means of a recording head, a preliminary auxiliary means, etc. If these are mentioned concretely, a preheating means to heat using the capping means, the cleaning means, the application of pressure or the attraction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head, and a reserve regurgitation means to perform the regurgitation different from record can be mentioned.

[0088] Moreover, although only one piece was prepared also about the class thru/or the number of a recording head carried, for example corresponding to monochromatic ink, corresponding to two or more ink which differs in an others and record color or concentration, more than one may be prepared the number of pieces. That is, although not only the recording mode of only mainstream colors, such as black, but a recording head may be constituted in one as a recording mode of a recording device or the paddle gap by two or more combination is sufficient, for example, this invention is very effective also in equipment equipped with at least one of each of the full color recording mode by the double color color of a different color, or color mixture.

[0089] Furthermore, in addition, in this invention example explained above, although ink is explained as a liquid It is ink solidified less than [a room temperature or it], and what is softened or liquefied at a room temperature may be used. Or by the ink jet method, since what carries out temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stability regurgitation range about the viscosity of ink, ink may use what makes the shape of liquid at the time of activity record signal grant. In addition, in order to prevent the temperature up by heat energy positively because you make it use

it as energy of the change of state from a solid condition to the liquid condition of ink, or in order to prevent evaporation of ink, the ink which solidifies in the state of neglect and is liquefied with heating may be used. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied also when using the ink of the property which will not be liquefied without grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when reaching a record medium. The ink in such a case is good for a porosity sheet crevice or a breakthrough which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the condition of having been held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0090] Furthermore, in addition, as a gestalt of this invention ink jet recording device, although used as an image printing terminal of information management systems, such as a computer, the gestalt of the reproducing unit combined with others, a reader, etc. and the facsimile apparatus which has a transceiver function further may be taken.

[0091]

[Effect of the Invention] Since it is made to perform recovery by the optimal mode according to the non-discharge condition of a nozzle according to this invention as explained above, a non-regurgitation nozzle can be canceled by consumption of necessary minimum ink, and buildup of a running cost and buildup of equipment size and equipment cost can be suppressed.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is a top view for explaining the electric outline configuration of the substrate for ink jet recording heads.

[Drawing 2] It is the top view showing the outline configuration of the important section of the substrate for ink jet recording heads shown in drawing 1 .

[Drawing 3] It is the outline perspective view showing the condition of having joined the top plate to the substrate for ink jet recording heads of drawing 1 , and having constituted the nozzle.

[Drawing 4] It is the sectional view of a nozzle circumference part which meets the a-a line of drawing 3 .

[Drawing 5] It is a timing diagram for explaining detection actuation of the existence of the ink in a nozzle.

[Drawing 6] It is a representative circuit schematic corresponding to the surrounding configuration of the ink detection electrode of the substrate for ink jet recording heads.

[Drawing 7] It is drawing showing the notional configuration for other ink detection.

[Drawing 8] It is the perspective view showing the outline configuration of the ink jet recording device which can apply this invention.

[Drawing 9] It is the block diagram showing the control system of the ink jet recording apparatus shown in drawing 8 .

[Drawing 10] It is drawing explaining the non-regurgitation detection condition of ink.

[Drawing 11] It is the flow chart which shows the 1st operation gestalt about the recovery of the ink jet recording apparatus concerning this invention.

[Drawing 12] It is the timing diagram which shows an example of the recovery action by reserve regurgitation mode.

[Drawing 13] It is the timing diagram which shows other examples of the recovery action by reserve regurgitation mode.

[Drawing 14] It is the flow chart which shows the 2nd operation gestalt about the recovery of the ink jet recording apparatus concerning this invention.

[Drawing 15] It is the flow chart which shows the 3rd operation gestalt about the recovery of the ink jet recording apparatus concerning this invention.

[Description of Notations]

85 Recording Head

86 Ink Tank

88 Attraction Recovery System Unit

89 Cap Member

90 Wiper Blade

100 Substrate for Ink Jet Recording Heads (Component Substrate)

101 Record Component (Heating Element)

102 Driver Element (Driver)

103 Latch Circuit

104 Shift Register

116 Alternating Current-Bond Part

118 Electrode for Detection

203 Wiring Section

205 Cavitation-proof Film

310 Delivery

311 Common Liquid Room

312 Nozzle Wall

314 Top Plate

405 Protective Coat (Insulating Protective Coat)

408 Nozzle Section

1000 Control Circuit

[Translation done.]